Clubroot Risk Mitigation Initiative:

Ensuring sustainable canola production on the Canadian prairies

Breeding Module

Proposed research projects

Clubroot Summit
Wednesday, April 29, 2009
Executive Royal Inn in Nisku, AB

Breeding Module: Proposed projects

Project		
• Development of molecular markers (MM) for resistant (R) gene(s) derived from *B. napus* and other species	Rahman	U of A
• Introgression of clubroot resistance into *Brassica rapa*	Rahman	U of A
• Introgression of clubroot resistance into *Brassica juncea*	Rahman	U of A
• Understanding the genetic relationships between resistance genes from different sources	Rahman	U of A
• Agronomic and seed quality improvement of germplasm carrying resistant gene(s) from allied species	Rahman	U of A
• Upgrading greenhouse and growth room facilities at the University of Alberta	Rahman	U of A
• Development of marker populations in the *Brassica oilseed species*	McVetty	U of M
• Identification of new sources of clubroot resistance in *Brassica* germplasm and development of new clubroot resistant/high erucic acid rapeseed (HEAR) cultivars	McVetty	U of M
• Genomics-Assisted Introgression of Clubroot Resistance (CR)	Selvaraj	NRC

Development of molecular markers (MM) for resistant gene(s) derived from winter *B. napus* and other species

(Rahman)

Objectives:

- **To identify MM for the resistant gene(s) for use in marker assisted selection and gene pyramiding.**
- **In the first step, MM for resistance from the winter canola cv. Mendel will be identified.**

Rationale:

- **Phenotypic expression of a trait is often the result of interaction between the gene(s) and the environment under which the plant is being grown (G x E).**
- **In case of disease resistance, G x E is often more complex.**
- **Visual assessment for resistance can be complex, and may lead to wrong classification of the plants → reduce the efficiency of breeding.**
- **If more than one resistant genes need to be incorporated, it is not possible to detect these genes by visual assessment of the plants based on resistance phenotype.**
- **MM will increase the efficiency and speed of resistance breeding program substantially.**
- **Effective way of pyramiding multiple genes into a canola cultivar.**

Introgression of clubroot resistance into *Brassica rapa* *(Rahman)*

Objectives:

To introgress clubroot resistance into Canadian oilseed *B. rapa*

Rationale:

- ***Brassica rapa*** **is still favoured by the canola growers in the SSZ, especially in the Peace River region.**
- **Clubroot has been found in canola fields in the Peace region.**
- **Oilseed *B. rapa* is susceptible to clubroot.**
- **Breeding efforts for the development of clubroot resistant cultivars is mainly focused on *B. napus* - no effort has been made for the development of oilseed *B. rapa* germplasm resistant to this disease.**

Introgression of clubroot resistance into *Brassica juncea* *(Rahman)*

Objectives:

To introgress clubroot resistance into *B. juncea* from its allied species

Rationale:

- ***Brassica juncea* has great potential in Canada – especially in the dry areas.**
- ***B. juncea* has many desirable traits, e.g. resistance to blackleg, silique shattering resistance, yellow seed (low fibre in meal), etc.**
- **Breeding efforts for the development of clubroot resistant cultivars is mainly focused on *B. napus* - no effort has been made for the development of oilseed *B. juncea* germplasm resistant to this disease.**

Understanding the genetic relationships between resistant genes from different sources *(Rahman)*

Objectives:

Understand the allelic relationships between different resistant germplasms

Rationale:

- **Clubroot resistance is available in different germplasm within a species.**
- **A knowledge on whether the resistant accessions carry the same gene or different genes would enable development of rational breeding strategies and appropriate deployment of different sources of resistance (*no need to work with multiple resistant germplasm if they carry the same resistant gene*)**

Agronomic and seed quality improvement of germplasm carrying resistant gene(s) from allied species *(Rahman)*

Objective:

To develop clubroot-resistant germplasm with improved agronomy and canola quality seed traits.

Rationale:

- **The allied species which carry clubroot resistance also carry many undesirable agronomic and seed quality traits.**
- **Introgression of clubroot resistance from allied species accompanied with several undesirable traits.**
- **Improvement of these traits in the resistant germplasm is essential for the development of clubroot resistant canola cultivar.**

Upgrading greenhouse and growth room facilities at the University of Alberta

(Rahman)

Objectives:

To improve the cooling and lighting systems of AFNS greenhouse, and purchase of growth chamber

Rationale:

- **Greenhouse complex in the Agric/Forestry at the U of A was built in 1981, which has never been upgraded except for the lighting system is being changed a few years ago.**
- **The Canola Program at the U of A uses the greenhouse facilities extensively to conduct research in different areas including clubroot research (*by both Rahman and Strelkov*).**
- **Temperature in greenhouse during the summer months goes >30 C *(even when cooling system set at 18-20 C).***
- **Most *Brassica* species are sensitive to high temperatures, and accurate and reliable phenotypic scoring is difficult, sometimes not possible, under this high temperature condition.**
- **Upgrading the cooling system in the greenhouse would increase the speed and efficiency of research, including clubroot research.**
- **Purchase of new growth chamber will enable conducting high-quality research, including research on clubroot resistance**

Development of marker populations in the *Brassica oilseed species*
(McVetty)

Objectives:

To develop marker populations in the Brassica oilseeds to enable mapping of clubroot resistance genes, and allow identification of molecular markers.

Rationale:

- **Crosses will be carried out between clubroot resistant and susceptible lines and double haploid or inbred marker populations will be created.**
- **These marker populations will be screened for resistance and the phenotypic data will be combined with genotypic data to develop molecular markers – an important tool for resistance breeding.**

Identification of new sources of clubroot resistance in *Brassica* germplasm and development of new clubroot resistant/high erucic acid rapeseed (HEAR) cultivars

(McVetty)

Objectives:

To identify novel sources of resistance for incorporation into resistance breeding efforts.

Rationale:

- **The identification of novel sources of clubroot resistance will enable a proactive approach to resistance breeding, ensuring that resistance is introgressed from a wide variety of sources, thereby contributing to its durability.**
- **The information and germplasm generated from the screening activities will be used to develop new canola and HEAR cultivars with clubroot resistance for production in western Canada.**

Genomics-Assisted Introgression of Clubroot Resistance (CR)

Selvaraj

Source*: *B. napus*; *B. rapa

***Current status*:**

- Identification of CR locus in linkage groups (e.g. MS06 in Mendel; CRb, dominant resistance gene in Chinese cabbage; similar work that report on markers – distant at this point – for CR)
- The major CR are believed to be derived from a common genomic area in ancestral Brassica.

***Proposed work*:**

- Development of genic molecular marker for CR to aid selection in breeding

Discussion